Space Weather Technical Forecast

Issued on Friday, 23 December 2022 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-class flares and G1/Minor Geomagnetic Storms throughout. Increasing chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with several minor C-class flares, the largest of which came from AR3171 in the northeast. There are currently 7 sunspot regions on the visible disc. AR3169 (Chi/Beta-Gamma) in the north is the largest region but with both the main portions of the leader and trailer sharing the same polarity and therefore magnetically simple. AR3171 (Cao/Beta), just east of AR3169, is showing some minor magnetic complexity. All other regions appear small and simple at the present time.

No Earth directed CMEs were observed in available imagery during the period, though a filament eruption in the southwest has been ongoing at the time of writing and will be assessed once imagery is available.

Solar Wind / Geomagnetic Activity: The solar wind as measured by DSCOVR at L1 was indicative of a transition into a weak High Speed Stream (HSS), likely from CH55/+. Wind speeds rose from slightly elevated, around 400 km/s to elevated, ending around 520 km/s. The density was around average initially, rising to slightly above average after 23/0230 UTC. The total IMF, Bt, has been weak to moderate, with Bz is varying between weakly positive and weak to moderately negative, +8/-10 nT. The phi angle was mostly positive (away from the Sun). Resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3), with an Active (Kp 4) interval 23/0000-0300 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels. High energy electron flux (greater than 2 MeV), as observed by GOES16, was at mostly Background levels. The associated 24-hour fluence continued on a steady trend well below Active (1e8 integrated pfu). Observed fluence at 23/0001 UTC was 1.53e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain Low, with occasional C-class flares. There remains a slight chance of M-flares throughout the forecast period, due to current Earth-facing spot groups and as departing spots are anticipated to be replaced by new regions from the far side.

Solar Wind / Geomagnetic Activity: A CME from 21st may give glancing impacts early 24th. There have also been numerous flares and peripheral CMEs recently and thus further transients cannot be ruled out. Solar winds are forecast to be slightly elevated or elevated through the period due to ongoing HSS effects.

Quiet to Unsettled geomagnetic activity is most likely, with spells of Active. There is a slight chance of G1/Minor storms throughout, most likely as Earth transitions to the HSS from CH56 later on Day 1 or early on Day 2 (23-24 Dec) and again on Day 4 (26 Dec) with the HSS from the unnumbered coronal hole.

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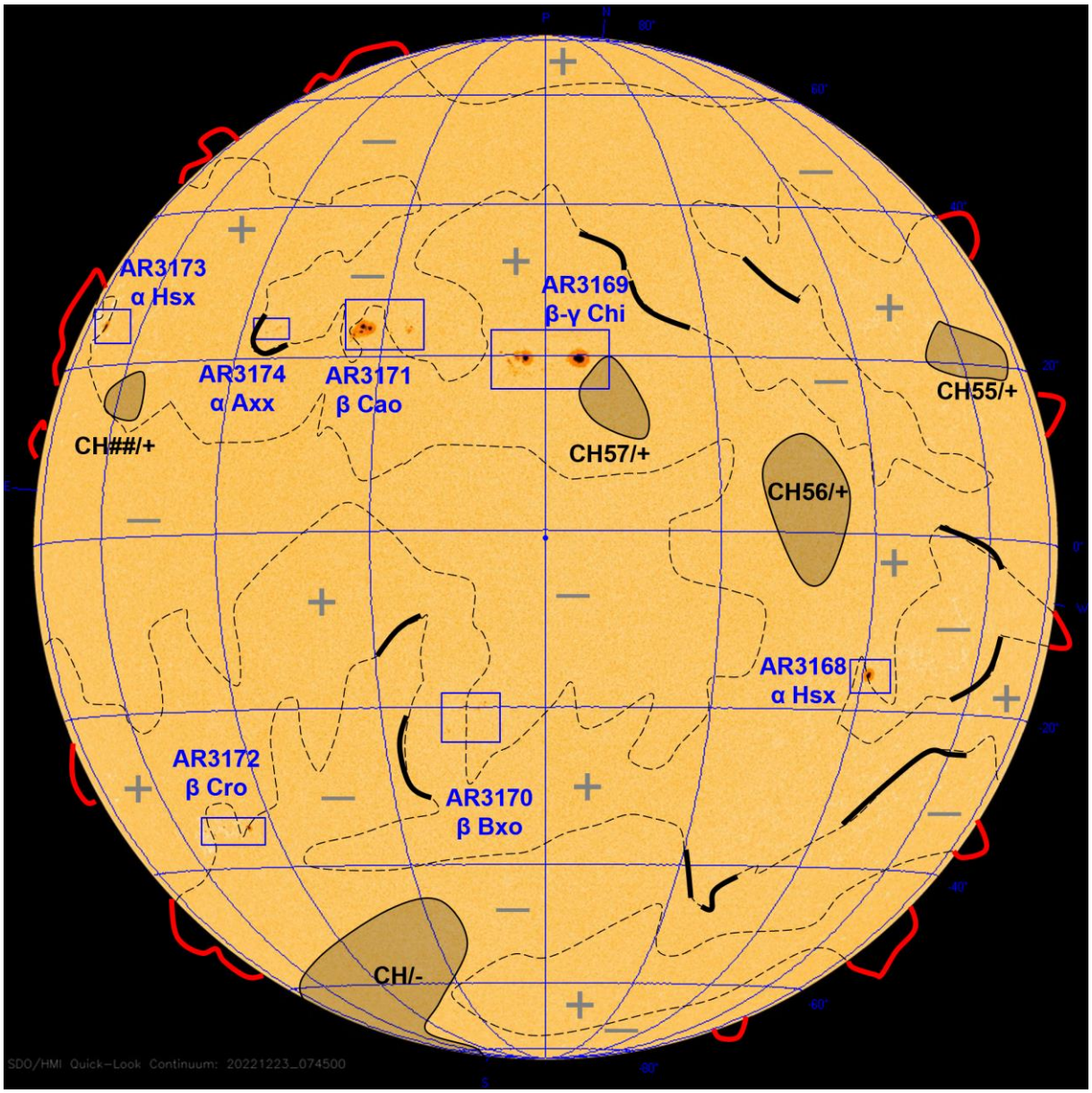
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels throughout. High energy (greater than 2 MeV) electron flux has the potential to increase due to HSS influence, perhaps reaching High levels on the diurnal peaks. The associated 24 hour electron fluence is forecast to remain below the Active (1e8 integrated pfu) threshold, probably with a rising trend, however it is likely that it will stay below Active.

Figure 1. Solar Analysis Valid 23/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME from 21st may give glancing impacts early 24th. There have also been numerous flares and peripheral CMEs recently and thus further transients cannot be ruled out.

Solar winds are forecast to be slightly elevated or elevated through the period due to the combination of HSS effects from CH55/+, CH56/+ and then CH57/+ near centre disc. This is in broad agreement with MOSWOC Enlil and the 27-day persistence model, and also with STEREO-A data, although the timing of peaks and troughs in wind speed should not be taken literally from any of these sources.

Quiet to Unsettled geomagnetic activity is most likely, with spells of Active. There is a slight chance of G1 Minor storms throughout, most likely as Earth transitions to the HSS from CH56 later on Day 1 or early on Day 2 (23-24 Dec) and again on Day 4 (26 Dec) with the HSS from the unnumbered coronal hole.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	15	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
21/1133	Partial	Filament eruption	NE	590 km/s	24/0800	Glancing blow possible

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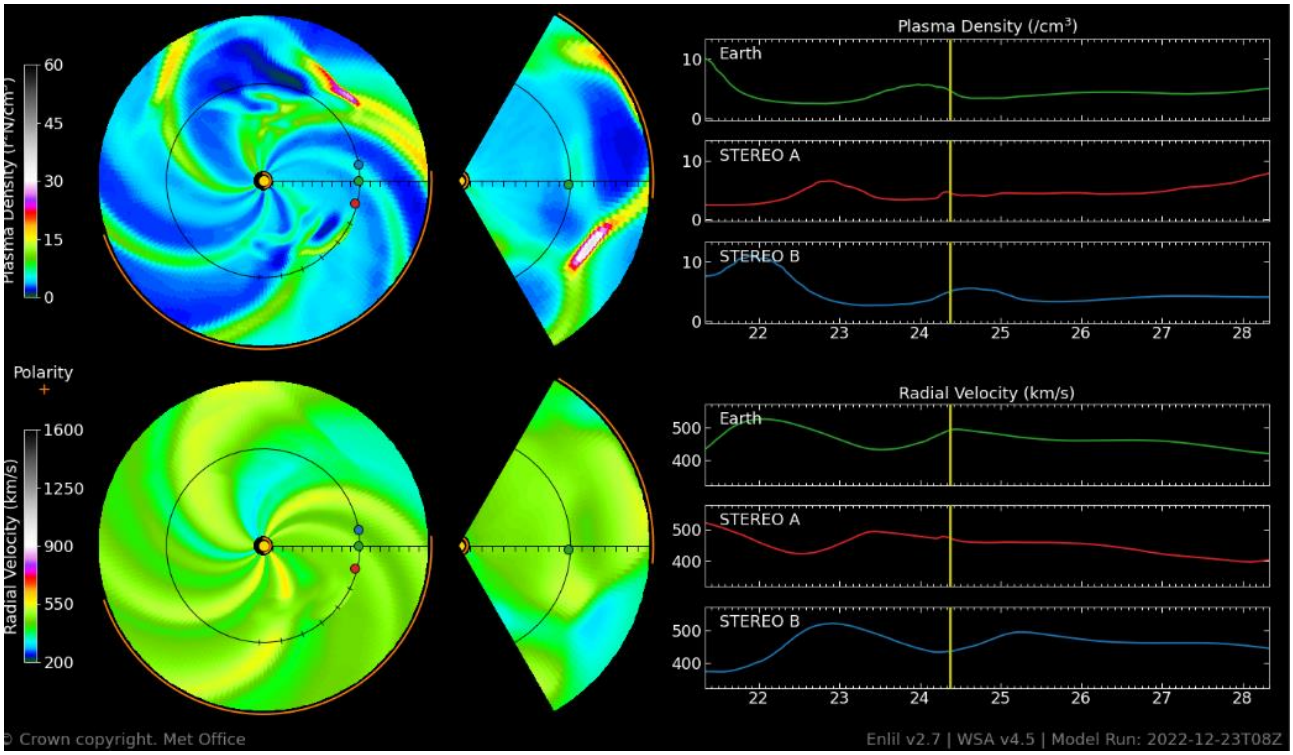
Figure 2: MOSWOC ENLIL



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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the past 24 hours with several minor C-flares. There are currently 7 sunspot regions on the visible disc. AR3169 (Chi/Beta-Gamma) in the north is the largest region but with both the main portions of the leader and trailer sharing the same polarity and therefore magnetically simple. AR3171 (Cao/Beta), just east of AR3169, is showing some minor magnetic complexity. All other regions appear small and simple at the present time.

The influence from AR3163 will reduce in the next couple of days, but there are another couple of potential regions to rotate on in that time. As such, a slight chance of M-class flares is kept consistent throughout.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is expected to remain at background levels. However, there is a very slight chance of an enhancement reaching the S1 Minor Storm level.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux as observed by GOES-16 is currently at largely background levels. Enhancements in the solar wind from coronal hole features through this period have the potential to result in increased electron counts, perhaps reaching High levels on the diurnal peaks later in the period.

The associated 24 hour electron fluence is forecast to remain below the Active (1e8 integrated pfu) threshold, but probably with a rising trend. On the previous rotation which was similar in terms of coronal holes, the fluence rose on the equivalent of Day 2 (24 Dec) but didn't quite reach Active for several more days. As such, fluence will probably rise during the period, however it is likely that it will stay below Active until next week. MOSWOC REFM is currently showing a fairly level trend through the next three days, but this is likely because it hasn't yet fully assimilated the recent rise in wind speeds.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	5	10	30	30
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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